MANPOWER RESEARCH MONOGRAPH NO. 20

Toward the Ideal Journeyman

Volume 3. APPRENTICESHIP TRAINING IN THE MACHINIST AND TOOL AND DIE MAKER TRADES

U.S. DEPARTMENT OF LABOR Manpower Administration

MANPOWER RESEARCH MONOGRAPH NO. 20

Toward the Ideal Journeyman

Volume 3. APPRENTICESHIP TRAINING IN THE MACHINIST AND TOOL AND DIE MAKER TRADES

1971

U.S. DEPARTMENT OF LABOR J. D. Hodgson, Secretary Manpower Administration

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 25 cents

PREFACE

This is the third volume of a monograph based on a study of apprenticeship. It concerns apprentice training for general machinists and tool and die makers. The overall study was completed in 1969. It was conducted under a contract with the Office of Research and Development of the Department of Labor's Manpower Administration by Prof. Alfred S. Drew of Purdue University's School of Technology and researchers in other disciplines. The Bureau of Apprenticeship and Training (BAT), as well as advisers from labor and industry, provided information for the study and gave invaluable guidance to the researchers during the conduct of the study and the preparation of the report.

The intent of the study was to appraise the strengths and weaknesses of the country's apprenticeship system in order to identify the elements that make up an optimum training program—that is, one of maximum effectiveness in meeting the Nation's needs for craftsmen. An integral part of a total training system is continuation training for journeymen to enable them to sharpen their skills and to learn new techniques to keep pace with technological change.

The portion of the study dealing with machine trades describes training received by apprentices and journeymen. It identifies methods for overcoming training problems not only in the machine trades but also in other industrial factory oriented trades. The first volume of the monograph concerns the "optimum" model for apprenticeable training; the appendix contains a checklist to aid in evaluating current programs or setting up new ones. The second

volume concerns training in the plumber-pipefitter trades in the construction industry. This third volume emphasizes the particular problems, the special needs, and the solutions found in the machinist and tool and die maker trades, which employ about half a million men.

CONTENTS

INTRODUCTION

The part of the study covered in this volume concerned only two of the machine trades—general machinist and tool and die maker. The functions of general machinists may be broadly characterized as production of parts, subassemblies, and assemblies, which may either become parts of finished products or replace broken parts. The functions of tool and die makers include the fabrication of tools, dies, punches, jobs, and measuring devices to be used in manufacturing. Both use the entire range of machine tools, such as lathes, milling machines, drills, grinders, and shapers.

Employers of the two trades overlap considerably. General machinists are employed in industries producing machinery of various types: transportation, electrical, chemical, food processing, and textile. They are widely employed in navy yards and in aviation, automotive, and railroad overhaul shops. Tool and die makers are commonly employed in automobile plants, electronic firms, aircraft plants, and plants that manufacture construction machinery, farm machinery, and business machines. Contract shops employ many, as do companies manufacturing electrical machinery and fabricated products.

The researchers for this study recognized that information from those who are currently being trained or who are working in the trade was most seriously lacking; thus, they sought data (1966-68 primarily) from all sources connected with the trade. Information and opinions from apprentices and journeymen were tabulated. Machine tool builders were questioned regarding new processes and tools. Training standards were studied and used to judge success in

meeting established goals. Those in charge of administering successful programs were quizzed, as were instructors, coordinators, and union and government officials. Employers—affiliated principally with the National Tool, Die, and Precision Machining Association (NTDPMA) and the National Machine Tool Builders' Association (NMTBA)—of both organized and nonunion tradesmen were interviewed, as were government officials with training responsibilities. The researchers were able to isolate certain problems, and frequently they noted that the industry already had reached solutions which needed only to be applied.

The researchers tried to determine what makes a good journeyman. In order to do so, they sent a rating form of positive journeyman characteristics to apprentices, journeymen, instructors, employers, and government officials connected with training, and manufacturers of machine tools. In all, over 1,150 respondents ranked seven different abilities. Overall skill, initiative, capacity for high-quality work, and ingenuity were the characteristics deemed most desirable. The other cluster included leadership, special skills, and teaching ability. The researchers concluded that the ideal machine trades journeyman would have an ability range that would allow him to handle any job, however unusual or complicated, and to move from one job to another with little supervision and maximum efficiency, turning out accurate and carefully completed work. The journeyman also would be able to perform even when the tools, equipment, and materials were not the best for the job.

It made no difference how large a company was; employers sought the same basic characteristics in their journeymen. Also, no difference was discerned in the trait rankings that were made by union business agents servicing primarily tool and die maker journeymen and those that were made by agents who serviced less skilled workers. However, government personnel tended to give much more weight to overall skill and high-quality work, while employers tended to give more weight to initiative and ingenuity.

The next phase of the research was to find out what kind of training workers actually had and what is needed to produce the "ideal journeyman." The details, reported in the following pages, point to a few major conclusions:

1. That traditional apprenticeship by itself is not enough; continuation training for journeymen is essential.

2. That although there are some means of keeping the training programs abreast of current developments, a systematic means of keeping the industry informed of new technology is badly needed.

3. That apprenticeship, while one of the oldest systems of training, is capable of adapting to new demands; recent apprentices are more likely to be older, married, and better educated than were those of a generation ago. At the present time, less well educated, disadvantaged youth are beginning to enter and programs are being set up to enable them to compete for apprenticeship openings with youth who have more traditional backgrounds.

ON-THE-JOB TRAINING

As in any trade, on-the-job training in the machine trades is intended to acquaint apprentices with actual work processes, to instill pride in craftsmanship, and to foster the qualities of initiative and ingenuity in actual job situations. A successful system of on-the-job training must provide work experience with up-to-date machinery and equipment, offer a breadth of experience, and be geared not only to production schedules but also to the needs of the apprentice. Ideally, progressively greater challenges to the apprentice are offered at each level of work experience. Journeymen are the prime source of trade instruction on the job, and a good OJT experience presupposses a good relationship with these ad hoc instructors.

Apprentice Experience

Most apprentices were 18 to 29 years old. About 35 percent were married when they started their apprenticeships. At the time of the survey, 56 percent were married; 3 out of 5 of these had "spouse and one or more dependents." Almost three-fourths of the apprentices had completed the 12th grade. An additional 22 percent had some form of post-high school work. About 59 percent had had no vocational courses in high school. Twenty-seven percent had had no industrial arts courses.

Nearly half of the apprentices were taught by journeymen who also had production assignments. One apprentice in 8 had a journeyman instructor who taught full time. And 1 in 4 reported that

his most recent instructor was a foreman or supervisor. A few apprentices were taught by company training employees who were not journeymen.

The instructors, for the most part, were in charge of from one to three apprentices. The apprentices indicated that their instructor was "good" to "excellent" in his trade performance. He also tended to explain things "very well," or at least well enough to enable the apprentice to do a task without serious error. About one-half of the apprentices felt that their instructors encouraged questions and comments and were otherwise very willing to help. Most indicated that the instructors showed a friendly attitude.

The apprentices surveyed rated their instructors higher than they rated the equipment they worked with on the job. However, the equipment ranked higher than their total on-the-job experience. A major complaint of apprentices related to the demands production made on instruction. One apprentice in 5 said that the journeymen and the instructors did not have enough time to help. Others complained of not having work assignments that were sufficiently varied or challenging.

Deliberate rotation of jobs at least once a quarter was reported by 80 percent of the apprentices. Only 1 apprentice in 10 indicated that he was hardly ever or never deliberately rotated. Some 60 percent felt every day of their on-the-job training was beneficial, while fewer than 10 percent claimed that their OJT experiences hardly ever helped them.

Reference materials were made available to roughly half of the apprentices, but one-fourth rarely saw such materials. Those who used the reference materials had little trouble understanding them. A majority of the apprentices believed that they could complete their usual work assignments without help from others. Of those who needed help, only 1 in 8 needed it as often as once a day.

Formal recordkeeping on the on-the-job experience was reported by 7 of 10 of the apprentices. Half of those who knew records were being maintained indicated that there was a close correlation between their actual production work and their projected schedule of work processes. But one-fourth of all apprentices felt that there was an appreciable variance; the rest maintained that there was a great difference.

The apprentices' ranking of quality of instruction, facilities and equipment, and overall training in order of excellence was echoed by the journeymen who had been through apprenticeship. The quality of training and the willingness of others to help made the

most favorable impression on journeymen. On-the-job training was held to be deficient in such areas as checking trade progress and following the scheduling of training on the job. Some journeyman machinists indicated that "work process planning" should receive more emphasis in OJT.

Recent Approaches

A number of programs employed a system for first-year apprentices which is worth noting. Under the program of the NTDPMA, an "instructor-coach" takes a group of about 15 men through 12 weeks of vocational instruction in both book and machine work. Then the "instructor-coach" spends the next 40 weeks of the program with the trainees in the shops to which they are assigned. The intensive program brings the disadvantaged youth, upon whom the program now concentrates (with the assistance of MDTA funds and the Labor Department), at least up to the level of beginning apprentices in conventional first-year programs; these youth then enter regular apprenticeship. This and other forms of preapprentice training may serve as an effective screening device for prospective employers.

Another approach was the machinist training programs' use of a "contact man" to counsel apprentices under his jurisdiction and to check their progress in shop assignments.

Other approaches noted were the "rotational system of scheduling"—a work-study, cooperative education program, in which periods of job training are alternated with periods of school training. "Multipurpose" training, discussed on p. 20, is also coming into broader use. And more formal training structures have been used to reduce training time. Such programs accept only highly qualified trainees. A "seasoning" period is usually required from the final employer, however.

RELATED INSTRUCTION

Through classroom and shop training away from on-the-job training, an apprentice can learn the trade theory that will be the groundwork for the job skills he will acquire. Such instruction can include anything which will make a machinist or a tool and die maker a more valuable employee.

Coordination of relevant trade subjects taught in related instruction with processes being learned on the job has high priority. Apprentices considered the main flaw in current programs to be the lack of correlation between related instruction and on-the-job training. Nearly half felt there was ample room for improvement in this area. The suggestion that classroom content be relevant to the job experience ranked first in their proposals to improve apprenticeship training.

Apprentice Experience

Apprentices generally attended classes during the regular school year. Three-fourths of them received related instruction in public school facilities. Some 6 to 8 hours of instruction a week were scheduled. If instruction was given during regular working hours, one or two sessions were held; if offered in the evening, classes met two or three times. Some two-thirds of the apprentices received regular pay for related instruction; one-fourth received nothing; the rest reported a variety of supplemental payments.

Apprentices showed a strong preference for separate instructors for each subject. They also preferred to have only their own trade

members in a class. The notion of "no trade theory" was emphatically rejected. They expressed a preference toward having theory taught before—or concurrently with—the need to apply it on the job. There was considerable diversity of opinion as to whether individual or group study was preferable; the largest group declared their preference for a combination, while a smaller number favored either group study or individual study supervised in a class.

Apprentices tended to rate nearly all instruction techniques—lecture, discussion, programed instruction, and demonstration—as equally valuable. Supervised study was thought to be somewhat less helpful, but it seemed that a variety of methods should be employed to keep the attention of the students.

Instruction aids vary from textbooks and work sheets, which are used by nearly every apprentice, to radio, recordings, television, and correspondence courses, which are used by very few. Pictorial aids such as films, snapshots, or slides were used perhaps once every five sessions by most apprentices and were considered helpful. Charts, graphs, posters, models, and cutaways were less used but elicited a favorable reaction from those who were exposed to them. Actual trade equipment and material was used by 3 out of 5 apprentices in at least 1 training session in 5. The equipment was considered modern by only half of those who worked with it.

Actual conditions in the most recent course the apprentices had taken were examined. It was found that generally the classes had apprentices only from the machinist trades. As might be expected, journeymen were rare. Between 16 and 20 trainees in a class was the common situation, although some 30 percent of the apprentices reported that their classes held more than 20 students. For nearly all apprentices, course content conformed to the announced goals; trainees were told what they needed to learn in order to pass, and lessons were assigned in advance. Objective, short-answer tests prepared by the teacher tested achievement for most apprentices. One in 5 reported the use of standardized tests and a similar proportion reported use of performance tests.

Two-thirds of the apprentices found that the presentations were, usually at least, clear and interesting. Instructor-trainee communication appeared to be good. Apprentices said they were encouraged to develop self-reliance and pride in craftsmanship.

Summing up the strengths and weaknesses of related instruction, apprentices cited as beneficial the opportunity to ask questions about their trade, the chance that training gave them to figure out new and difficult problems, and the exposure to practical job-

related information. The drawbacks, while noted by fewer apprentices, were more specific: not enough time spent with new materials and processes, lack of qualified instructors, lack of good texts, too much emphasis on "unrelated academics," and low pay or no pay. All the same, most apprentices rated their latest course as either "good" or "excellent."

Course Content

In view of limited time and resources for related instruction, where should the emphasis be? How much reliance should be placed on experience of present and former apprentices? How much on present analyses of the trade? How much on projections?

Journeymen with more than 15 years' trade experience were inclined to want all presently required courses retained. Some suggested that courses be added to the curriculum or that courses be expanded. General machinists and tool and die makers were in accord that their most valuable related instruction course was mathematics, followed by drafting, as shown by the following tabulation:

Subject	*Ranking*	
	General Machinists	*Tool and Die Makers*
Mathematics	1	1
Drafting/drawing	2	2
Blueprint reading	3	4
Machine shop	4	9
Machine operation	5	8
Hand and machine tools	6	10
Theory	7	7
Physical sciences	8	6
Trigonometry	9	5
Tool/die design	10	3

Courses which general machinists suggested adding were: welding, additional math, new shop methods, metal identification and use, and basic electronics. Tool and die makers suggested more math and trigonometry, more tool design and theory, and better communications.

Apprentices listed courses they considered should be mandatory; in order of priority they were: mathematics, drawings/print reading, trade technology, metallurgy, science, economics, hydraulics, industrial relations, psychology, aviation related subjects, English, and

labor history. Not surprisingly, these were the same as the courses which journeymen considered the most important.[1]

Occupational Analysis

The information just discussed is helpful in laying out a curriculum, but does not take the place of an occupational analysis, which identifies the processes that comprise a trade. Data acquired through analysis can be organized into a planning guide for laying out programs of related instruction. However, such guides were not in use in the machine trades. In formulating their own analysis, the researchers used a work diary in which tradesmen recorded their day-to-day activities.

In some tentative curriculum planning based on their analysis, the researches identified five major work divisions within the machine trades—material forming, bench work, fitting and assembling, inspecting and testing, and heat treating. These blocks may be divided into operational units, such as grinding, drilling, or finishing. Finally, specific operations or activities can be identified, such as "grinding a taper on a cyclindrical grinder."

A sample page of the guide (table 1) illustrates this dissection process. It identifies an operation ("how") with a tool ("what"). For example, the operation "counterboring (material) on a radial drill press" can be designated by the code "6" in the column under drilling and the line across from radial drill press. The guide offers a way of keeping track of and recording activities for programing instruction. It does not determine what the content should be—occupational analysis must do that.

While the analysis can indicate the processes which are going on at the present, it cannot by itself indicate the direction training must take to accommodate future technology. The manufacturer who develops the new equipment, materials, and processes must play a part in alerting trainers to them.

The researchers invited manufacturers to forecast changes in equipment, materials, and processes which would be occurring in the near future. Manufacturers predicted that such changes will center on automation and computer control, numerical control devices, and the like.

---

[1] See Morris A. Horowitz and Irwin L. Herrnstadt, *Training of Tool and Die Makers* (Boston, Northeastern University, 1969) p. 157 for a similar rating by tool and die makers.

TABLE 1. EXAMPLE OF CURRICULUM PLANNING GUIDE OPERATIONS AND ACTIVITIES

BLOCK: Material Forming
OPERATIONAL UNITS: Turning-Boring, Drilling, Grinding, others.

Turning-Boring
1. Turning to a shoulder
2. Turning a taper
3. Turning an eccentric
4. Turning between centers
5. Boring a taper
6. Turning a thread

Drilling
1. Drilling
2. Spotfacing
3. Countersinking
4. Center drilling
5. Reaming
6. Counterboring

Grinding
1. Surface grinding
2. Cylindrical grinding
3. Form grinding
4. Internal grinding
5. Grinding a taper
6. Grinding an angle

Milling-Slotting
1. Form milling
2. Milling a groove
3. Plain milling
4. End milling
5. Milling flutes
6. Gang milling

WHO?		WHERE?		WHAT?	HOW?			
A	J	Rel	OJT	Operations on:	Turning-Boring	Drilling	Grinding	Milling-Slotting
				Engine lathe	1,2,3,4,5,6	1,2,3,4,5,6		
				Tracer lathe				
				Turret lathe	1			
				Sensitive drill press				
				Radial drill press		1,2,3,4,5,6*		
				Horizontal boring mill	*Example of "read-out" of operation: Counterboring (material) on a radial drill press.			
				Jig borer				
				Column and knee mill				
				Vertical mill				4
				Planer mill				
				Cylindrical grinder			2,3,4,5,6	
				Internal grinder				

Key: A=Apprentice, J=Journeyman, Rel=Related Instruction, OJT=On-the-Job Training

The skills manufacturers indicated would be needed in greater degree in the future are: diagnosing malfunctions; operating control instruments; running complex, highly automated equipment; and handling such precision devices as oscilloscopes, leveling equipment, and digital readout measuring systems. The researchers concluded that such machine trades as those of maintenance machinists, electronics technicians, operators, and manufacturing engineers would be expanding faster than such traditional trades as general machinist and tool and die maker.

ADMINISTRATION

The body responsible for administering the training program has a large task. Problems exist concerning adequate facilities and equipment for related instruction; the facilities tend to be public school buildings. Training materials must also be adequate. The problem of obtaining journeymen trained in teaching and technically up to date warrants special emphasis. Proper recordkeeping is essential to assure that apprentices are receiving the instruction they should have and to assure appropriate credit for work completed. Testing of trade progress requires the attention of the Joint Apprenticeship Committee (JAC) or other controlling body—not just that of the instructor.

Trainees were generally in programs where each subject was taught by a different teacher, although some were exposed to team teaching and others to a single instructor for all facets of related instruction. Nearly 2 out of 3 apprentices did not have an opportunity to hear a technical representative or some other trade resource person even once a semester. Only a small percentage of trainees ever had classroom visitors, either labor, management, or JAC representatives.

When apprentices were questioned on the competence of their most recent instructor they responded favorably, but not enthusiastically. While trainee-instructor communications in many cases appeared to be good in both on-the-job training and related instruction, some apprentices indicated that explanations were not clear and that classes were not interesting. One-fourth of the apprentices

identified lack of qualified instructors as a particularly serious drawback in related instruction.

Some 40 percent of the journeymen indicated that they had served as instructors, and about the same percentage had taught on an informal basis when someone asked for help. The most frequent type of instruction experience was with apprentices on the job. Only a small proportion had conducted a related instruction course. Average years of teaching experience came to about 9; however, less than one-fourth of those who had served as instructors had been given any training for the task. If a journeyman had instruction, it was usually provided by the employer.

Interest in teaching was not high among either apprentices or journeymen; those who were willing to instruct normally attached conditions for their service—specifically, adequate pay and instructor training. About one-fourth of the journeymen indicated that they were not interested in serving as an instructor under any conditions.

Apprentices were asked if they would like to serve either as an OJT instructor (following completion of their apprenticeship) or as a related instruction teacher. Nearly 1 in 3 indicated that they would serve without reservations as an on-the-job instructor, but only 1 in 10 would teach related instruction.

The best training programs visited by the researchers generally had full-time training staffs and more than one or two qualified instructors. They also had systematic recordkeeping procedures. Good physical facilities, good instruction materials, and reasonable trainee-instructor ratios (between 8 and 15 to 1) characterized the programs. Tight control on absenteeism was maintained. The programs tended to offer training not just for apprentices and journeymen but for technicians, engineers, and supervisors as well.

Some programs were developing a "multipurpose approach" to training. Their aim was to develop all-round craftsmen, machine specialists, supervisors, and technical staff by using a core of general trade courses and then offering specialty options. One of the emerging trade plans proposed an initial, 2-year apprenticeship in all basic areas of the trade for all trainees related to that trade. Subsequent training and development would depend upon performance appraisal, each trainee's capability, and his personal preference. While some trainees would be guided into a third and final year of specialist training, others would be counseled to go into either journeyman training or supervisory and technical training for 2 more years.

An advisory labor-management committee assisting the researchers was invited to submit a list of essentials for a high-quality program. It suggested that the responsible body must be capable of administering the training program, that is, carrying through on policy decisions. It must assure itself that every trainee is learning what is expected of him, is being rotated through the trade, and is receiving necessary guidance.

The committee also stressed that communication must exist among all parties to training. In union shops the training program must be negotiated with the union, as the key to providing a good general climate for labor-management relationships. Unnecessary overlapping of jurisdiction between State and Federal agencies or any other parties should be avoided. The program should be registered with the appropriate Government agencies, however.

Continuity of funding is important, the advisory committee stressed. Proper funding will not leave economic "holes" in the training coverage. Provision should exist also for alleviating the initial high costs of apprenticeships for employers, it was suggested.

Selection procedures should follow established criteria; however, they should not exclude those whose motivation is high but whose academic background would disqualify them. For these candidates, some form of special remedial assistance should be available. Where prejob training is given, it should be correlated with the apprentice program.

The curriculum should be geared to the needs of the trade, not just to the special needs of individual employers. Training materials should be up to date and available in sufficient quantity. Merely because a company is small, it should not be deprived of experienced training personnel. Smaller companies should be able to participate in joint training programs.

The entire training program should have available an adequate number of journeymen who have been trained as teachers and who have not lost touch with technical development in their fields. Journeymen must be willing to impart their knowledge and skills to apprentices. Related instruction should be closely correlated with jobsite training; the latter should be planned and executed so as to provide a well-balanced work experience. If one employer does not have all the basic tools with which to work, job experience should be afforded at another location.

The advisory group felt that graduation should be marked by a suitable recognition of achievement—tools, perhaps, or a bonus.

Finally, the controlling body must constantly review the program to see where improvements may be made and to keep up with new developments elsewhere.

UPGRADING AND KEEPING PACE

The researchers attempted to identify the mechanisms affecting the ability of the labor force to keep up with industry's changing needs. Keeping subject matter and training methods current is essential to an optimum apprenticeship training system. For the journeyman, continuation training is necessary to combat skill obsolescence. For the manufacturer, it is vital that there be enough tradesmen with current skills to handle the innovations flowing from developing technology.

Apprentices and journeymen employed similar techniques to keep current in their trade. The methods which apprentices most frequently mentioned—discussion with fellow workers and reading trade journals—were also most frequently cited by journeymen. However, the journeymen also credited supervisors as prominent sources of trade information. (See tables 2, 3, and 4.)

As in the other trades studied, the researchers noted that the outstanding apprentice training programs in the machinist trades had complementary programs for upgrading and updating the skills of the journeyman. Yet less than 30 percent of the journeymen reported having participated in some type of organized training during the 2 years preceding the survey. About one-third of the journeymen had participated in a trade-related training course of at least 10 hours within the preceding 5 years.

About one-third of the journeymen had been to another worksite within the previous 2 years in order to observe work operations. Most felt that the trip was beneficial; this was an indication that planning and coordination, particularly in a factory setting, lead to

TABLE 2. METHOD OF KEEPING UP WITH MACHINIST TRADES AS REPORTED BY APPRENTICES[1]

Method of keeping up with trade	Aggregate frequency (includes all responses, single or multiple, of each respondent)	
	Number	Percent
Discuss with fellow workers	193	75
Trade journals	113	44
Manufacturing service bulletins	65	25
Off-the-job instructor	58	22
Union reports	41	16
OJT instructor	21	8
Attend special training school	21	8
Discuss with manufacturing representatives	15	6
Other	13	5

[1]Number of those queried equaled 258.

TABLE 3. TOOL AND DIE MAKERS, METHOD OF KEEPING UP WITH TRADE AS REPORTED BY JOURNEYMEN[1]

Method of keeping up with trade	Aggregate frequency (includes all responses, single or multiple, of each respondent)	
	Number	Percent
Talk with workers in my trade	49	61
Trade journals	46	58
Foreman and supervisors	35	44
Talk with company engineers	22	28
Manufacturing service bulletins	19	24
Talk to workers in other trades	12	15
Manufacturing representatives	11	14
Special union reports	9	11
Talk to instructors in my trade	7	9
Talk with union representatives	5	6
Talk with family	5	6
Other ways	4	5
Talk with others	3	4
Attend public vocational school	2	3
Talk with inspectors	2	3
Attend other training schools	1	1
Talk with friends	11	14

[1]Number of those queried equaled 80.

TABLE 4. GENERAL MACHINISTS, METHOD OF KEEPING UP WITH TRADE AS REPORTED BY JOURNEYMEN[1]

Method of keeping up with trade	Aggregate frequency (includes all responses, single or multiple, of each respondent)	
	Number	Percent
Talk with workers in my trade	79	71
Foreman and supervisors	51	46
Manufacturing service bulletins	38	34
Trade journals	35	31
Talk with company engineers	20	18
Talk to workers in other trades	17	15
Manufacturing representatives	15	13
Special union reports	11	10
Talk with friends	11	10
Talk with inspectors	10	9
Talk to instructors in my trade	8	7
Talk with union representatives	8	7
Attend public vocational schools	5	5
Attend other training schools	5	5
Talk with family	4	4
Talk with others	5	5
Other ways	6	5

[1] Number of those queried equaled 112.

increased dividends. Although half of all journeymen questioned indicated that they were interested in participating in trade contests, only a small number had participated in the preceding 2 years.

Sixty percent declared that "not being in touch with new developments" was a "moderate" to "serious" problem. The number of journeymen who felt that they needed to do some cramming in order to complete assigned tasks was substantial. One-third of the journeymen did so on a regular basis. More than one-half admitted the need for occasional "boning up" or "brushing up."

Some 16 percent of the journeymen indicated that their employer required them to take some schooling as a condition of continued employment, while a smaller group was required by joint labor-management rules to take training. Less than half of the tradesmen received their regular hourly pay for participation in training or received aid with materials and/or tuition. A few, however, were paid premium overtime compensation.

Among the survey's findings was that 44 percent of journeymen definitely wanted more training; an additional 19 percent wanted it if it were required for job retention or for promotion. Whether a journeyman was a general machinist or a tool and die maker did not appear to affect his attitude. Younger workers and those who were married tended to favor training more than did older or single workers. Whether a tradesman had completed high school was another factor: those who had done so wanted more trade schooling. Obviously, those who had indicated skill obsolescence to be a problem were more likely than others to want additional training.

When journeymen were asked how much they were willing to spend on training, fewer than half responded that they would pay anything over $1 an hour; and one-fifth would not pay any amount. A small fraction would spend up to $3 an hour if they felt in need of training.

About the same breakdown appeared when the investment was stated in annual terms. Some 44 percent would pay varying amounts under $100 a year; the remainder were divided between those who would invest more and those who would pay nothing for continuation training.

More than 80 percent of the journeymen reported that, if they felt they needed training, they would attend classes either "once a week" or more often on their own time. The same percentage said they would travel 4 or more miles to get the training they needed.

The training environment and manner of training were not neglected. The study determined that more than three times as many journeymen wanted training conducted at the jobsite as wanted training conducted elsewhere or home study. About one-third wanted a combination of individual and group instruction, as opposed to one-fourth who preferred only group teaching and one-fifth who preferred individual instruction, either at a central location or at home. The rest expressed no preference. While tool and die makers exhibited a strong preference for learning trade theory, general machinists leaned toward instruction combining both trade theory and manual skills.

When questioned as to whether there should be separate instructors for trade theory and manual skills, approximately half of the apprentices responded positively and half negatively. There was a preference for learning trade theory before or at the same time that it is needed on the job.

It is emphasized that journeymen want the assurance of being able to apply their training on the job. Other conditions which

journeymen set were pay for time spent in training, joint program sponsorship by an employer and labor group, and reimbursement for expenses.

Manufacturers of machine tool equipment were asked their views on the adequacy of current programs in preparing tradesmen to handle innovations and to assimilate technological change. (These manufacturers also employed tool tradesmen and conducted inplant training.) Only 1 manufacturer in 4 thought that present courses would be adequate to meet the needs of the trade 5 years hence. Some said that more training in theory was needed; a smaller number spoke out for more on-the-job training. Dissatisfaction with their own programs varied from unease over the quality of the trainee in a tight market to concern that instructors were not keeping up with the trade.

Manufacturers tend to produce training materials and provide installers when the machinery is complex or the product new, requiring special tools and new methods. About one-third of the builders said that they developed training materials. Two firms in 7 furnished materials or instructors to apprenticeship programs; half of these firms sent both instructors and training material which was generally descriptive literature. Even when the materials furnished were prints, tools, laboratory equipment, and materials, the costs were borne by the manufacturer; rarely was even a token charge made.

Most of the manufacturers used installers and instruction manuals; 1 firm in 3 conducted a training program for customers' employees. One-fifth of the firms prepared information to "update" journeymen. To keep their own employees current, some builders emphasized modern equipment, use of trade association training manuals, and periodic review of instruction content.

Release of new product information was generally made through trade magazines and direct mailings. Few firms indicated that they would employ such techniques as serviceman training schools and direct customer assistance even for a new product that required new operations. The survey posed a hypothetical case of a new product that is promised to increase company sales by 30 percent. Results showed that in this case considerably more effort would be expended by manufacturers; marketing would involve instructive literature, sales promotion, training programs, and trade schools.

"Lead time" is that time required for workers to adapt to new technology. From responses to questions, the researchers concluded

that lead time may require anywhere from 1 to more than 5 years, depending on the manufacturer, the product, and the training technology available.

Of the sources of resistance to new technology—those responsible for the specifications of equipment, labor unions, and individual journeymen—the journeymen posed less of a problem in the manufacturers' view than did labor unions or owners, mechanical superintendents, foremen, and engineers responsible for equipment acquisition. Those who buy from the manufacturers posed a problem for more than two-fifths of the manufacturers responding. Labor unions were listed as an obstacle by 29 percent, and individual journeymen by 13 percent. Other possible sources of trouble, such as corporate management or committees who write machine-tool specifications, gave negligible resistance to new technology in the view of the vast majority of manufacturers. However, almost half of the manufacturers felt that machine-tool specifications played a great role in shaping the course of research and design conducted in their companies. In order to change specifications, manufacturers indicated that they would work for changes through legislative bodies while at the same time alerting customers to the advantages of the new product or material. Three manufacturers in 10 indicated that they had at once time or another attempted to change or modify a government code to introduce new technology.

The researchers concluded that while no formal or comprehensive method for sensing coming technology and adjusting to it was at work in the tool trades, training systems could use the manufacturers' expertise in translating new technology into trade training content.

KEYS TO EFFECTIVE TRAINING

In most respects the features of outstanding programs in the machinist trades were similar to those of top programs in the pipe trades discussed in volume 2 of this monograph. One feature was a belief in the viability of apprenticeship as a source of skilled workers. This belief was often expressed through published declarations of policy. Other features included: definite budget for training; employment of a full-time training staff; written apprenticeship agreements or indentures; a systematic recordkeeping procedure; periodic testing of trainees; use of several qualified instructors; a complementary training program for journeymen; fairly large enrollments in training programs; good physical facilities both for related instruction and for development of selected manual skills; good instruction materials, including textbooks and other learning aids; reasonable trainee-instructor ratios (from between 8 and 15 to 1); and tight control on absenteeism. (See "Appendix: Some Essentials of an Optimum Training System" in volume 1 of this monograph.)

Between the two trades, top programs varied on certain points. Outstanding programs in the machine-tool trades provided a wide range of training, covering not only apprentices and journeymen but also technicians, engineers, and supervisory personnel to a greater extent than did programs in the pipe trades. The dispatch of trade instructors to manufacturers' schools to learn new technology was a rather common practice in the machinist trades. While the pipe trades employed coordinators and instructor-coordinators to teach related instruction and maintain contact with the apprentice

on the job, the machinist trades tended to use an "instructor-coach" or "contact man" who counseled each first-year apprentice under his jurisdiction, and scheduled and checked the progress of the trainee in shop assignments.

The research team concluded that while the elements that go to make up a good system of training are known, the weaknesses in the system stem from the failure to administer, coordinate, and control—that is, to put into practice—these well-recognized elements. On the basis of responses from apprentices, journeymen, employers, union officials, manufacturers, and others, it became apparent that certain distinct characteristics made "outstanding" trade training programs. To repeat, these programs can be defined as those producing the "ideal journeyman"—one who possesses the overall skill to handle any job in the trade however complicated; who has the initiative to move from one job to another with a minimum amount of supervision; who produces high-quality work; and who has the ingenuity to accomplish whatever task is assigned even though the tools, materials, or equipment available may not be the best for the job.

☆U.S. GOVERNMENT PRINTING OFFICE : 1971 O - 437-209 (33)

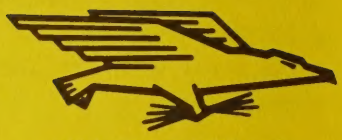
WHERE TO GET MORE INFORMATION ABOUT MANPOWER PROGRAMS

The major purpose of the U.S. Department of Labor's Manpower Administration is to bring people and jobs together. For more information on manpower programs and services in your area, contact your Regional Manpower Administrator at the address listed below or the nearest office of your State employment service.

Location	States Served		
John F. Kennedy Fed. Bldg. Boston, Mass. 02203	Connecticut New Hampshire	Maine Rhode Island	Massachusetts Vermont
341 Ninth Avenue New York, N.Y. 10001	New Jersey Virgin Islands	New York	Puerto Rico
P.O. Box 8796 Philadelphia, Pa. 19101	Delaware Virginia	Maryland West Virginia	Pennsylvania
D.C. Manpower Administrator 14th and E Streets, NW. Washington, D.C. 20004	District of Columbia		
1371 Peachtree Street, NE. Atlanta, Ga. 30309	Alabama Kentucky South Carolina	Florida Mississippi Tennessee	Georgia North Carolina
219 South Dearborn Street Chicago, Ill. 60604	Illinois Minnesota	Indiana Ohio	Michigan Wisconsin
411 North Akard Street Dallas, Tex. 75201	Arkansas Oklahoma	Louisiana Texas	New Mexico
911 Walnut Street Kansas City, Mo. 64106	Iowa Nebraska	Kansas	Missouri
Federal Office Bldg. 1961 Stout St. Denver, Colo. 80202	Colorado South Dakota	Montana Utah	North Dakota Wyoming
450 Golden Gate Avenue San Francisco, Calif. 94102	Arizona Nevada Trust Territories	California American Samoa	Hawaii Guam
Arcade Plaza 1321 Second Avenue Seattle, Wash. 98101	Alaska Washington	Idaho	Oregon

U.S. DEPARTMENT OF LABOR
MANPOWER ADMINISTRATION
WASHINGTON, D.C. 20210

OFFICIAL BUSINESS
Penalty for private use, $300



POSTAGE AND FEES PAID
U.S. DEPARTMENT OF LABOR

THIRD CLASS MAIL